International Council for the
Exploration of the Sea

C.M.1975/E:1
Administrative Report

FISHERIES IMPROVEMENT COMMITTEE

by

P. Korringa

Belgium

(R. de Clerck)

The studies of the effects of the dumping of industrial waste along the Belgian coast on the stocks of fish and shrimp and on plankton and invertebrates were continued. In two areas of dumping sampling was carried out on a monthly basis by means of research vessel catches.

The determination of heavy metals, PCB's and pesticides in fish and shrimps was continued. Two monitoring programmes were carried out. The first concerned shrimps, plaice, sole, cod and whiting off the Belgian coast. The second concerned soles from the North Sea, the Bristol Channel and the Irish Sea.

Canada

(E.G. Bligh)

Salmonid Culture

An experiment designed to determine the difference in the nutrient requirements of rainbow trout grown in fresh water as compared with those reared in salt water has been completed. Growth data indicate that protein utilisation is better in salt water than fresh water. Other biochemical analyses from this experiment will be completed shortly.

An experiment is in progress to determine the protein and energy requirements of the Atlantic salmon (Salmo salar). The response criteria for this experiment include : growth, feed efficiency, net protein utilisation, energy retention and the change in liver glycogen, protein and lipid levels. This information is required for developing diets to reduce for Atlantic salmon the time required in fresh water prior to smolting.

Cage rearing of Atlantic salmon in saltwater was continued through 1974 near Halifax, N.S. The objective was to produce "steak-size" (2.2 to 4.5 kg) fish, and although several mortalities occurred, good growth rates were achieved. By the end of December 1974, one production group (18 months in salt water) had achieved a size of 2.7 kg. The second group of salmon reared for six months to end of December, 1974, averaged 1.1 kg. Major problems encountered so far in the rearing programme included superchilling of water and toxic phytoplankton blooms in winter. The best rearing facility tried so far has been a knotless nylon net weighted on the bottom and hung from a floating platform.

There was a significant increase in the numbers of hatchery-reared fish contributing to the Atlantic salmon spawning escapement in the St John River, New Brunswick, in 1974. Of 13 847 adult salmon captured at Mactaquac Dam, 5 632 (40.7%) were of hatchery origin, compared with 2 371 adult hatchery-reared fish returning in 1973. Hatchery stocks are also being used effectively in developping a run of Atlantic salmon in a tributary of the LaHave River, Nova Scotia.

Adult salmon passing through the fishway at Morgan Falls in 1974 totalled 381, of which 339 (89%) were identified as hatchery-reared fish.

Pathogenic fish diseases significantly affected juvenile Atlantic salmon rearing programmes at two Nova Scotia hatcheries in 1974. The pathogenic bacterial disease, Pasteurella sp. was tentatively identified at Kejimkujik Hatchery in Atlantic salmon fingerlings and yearlings. This was the first record of Pasteurella sp. in Canadian waters and because of the seriousness of the disease, all stocks had to be destroyed. The Atlantic salmon rearing programme at Margaree Hatchery has been terminated because of continued infection of stocks with Corynebacterial kidney disease.

Three homemade diets using various scrap fish (cod viscera, herring heads and tails, and sea cucumber meal) were compared with three brands of commercial pellets on the growth of rainbow trout in floating fish pens. The homemade diet, consisting of cod viscera, herring meal, wheat middlings whey powder and a vitamin pack, proved superior. In another trial, 1 000 lb of sea cucumbers were processed at a local fish meal plant and substituted for fish meal in a trout diet. Proximate analysis, amino acid spectrum and carotenoid content seemed suitable. However, there was a palatability problem and the fish did not eat or grow well.

From a series of pink salmon (Oncorhynchus gorbuscha) egg plantings during the early 1960's from British Columbia to North Harbour River, St Mary's Bay, Newfoundland, a small stock of natural spawning fish was established. Returns from these fish are steadily declining. The total number reported in 1974 was 28, distributed as follows : 18 in North Harbour River, 5 in the commercial fishery, and 5 observed in other rivers. All returns were from St Mary's Bay. These were the progeny of 58 adults which spawned in 1972 and a subsequent fry run of 37 000 during the spring of 1973.

Lobsters

Juvenile lobster nutrition studies showed no effect of added dietary glucosamine of B-carotene on growth, molt survival or pigmentation compared with the control artificial diet. The addition of dietary mineral mix significantly improved growth, molt and survival of juvenile lobsters.

Studies to determine the lipid soluble vitamin requirements of juvenile lobsters were initiated in November 1974.

Adult lobsters have been shown to require approximately 5% of the dry weight of the diet as lipid. Cod liver oil is significantly better than corn oil or coconut oil as a dietary lipid for adult lobsters based on growth, percent edible meat and other condition factors. A cholesterol deficiency was shown in lobsters fed a sterol-free diet for 10 months.

The GLC analysis of adult lobster tissue fatty acid composition and the effects of dietary lipids on this composition are in progress. This will complete work on the 10-month live animal trial carried out to determine protein and lipid requirements of adult lobsters.

A pilot scale lobster culture facility is being contructed at the St Andrews, N.B., Biological Station to evaluate the economic feasibility of lobster culture. Primary emphasis will be on maximum production at minimum cost with locally available materials. The plant, scaled to annual production of 1 000 lb, will incorporate research facilities and a small shellfish culture unit to evaluate the multiculture potential.

Antibodies have been prepared against the "female protein" in the yolk of lobster eggs so that onset of ovarian maturation can be determined and time of egg laying predicted. Additional work on the female reproductive cycle has revealed that the traditional concept of molt and egg laying in alternate years is only partially correct. One age class predictably molts and lays eggs in the same summer, and these females are valuable for culture purposes because offspring of planned matings may be obtained in a short time.

Cape Breton Aquaculture Development

The third year of a major program of aquaculture development was completed in Cape Breton Island, which makes up the eastern quarter of the Province of Nova Scotia and contains an extensive (1 100 km^2) brackish (20-24‰) lake system. To date the program has comprised three major areas of effort:

1. The description of the marine and selected freshwater areas in terms of their physical, chemical and biological parameters, and an assessment of their aquaculture potential;

2. Investigation of the biology of selected target species, development and testing of production and marketing technology and its economic evaluation. Species currently under study include : oysters, salmonid fishes, mussels, eels and marine algae;

3. Commercial through pilot to full commercial scale production and marketing of species for which applicable and economically promising rearing technology is available.

Oysters presently growing, largely using suspension techniques, are projected to produce a ten-fold increase (10 000 bu) in annual production from the island in the next two years.

A pilot commercial scale rainbow trout rearing operation using marine cages, produced 25 000 lb in 1974. A production target of 300 000 lb is planned for 1975. Another pilot scale commercial rearing operation will begin in 1975 for mussels.

Use of Thermal Effluent for Aquaculture

A Federal-Provincial Coordinating Committee is continuing to study the potential for use of thermal effluent from an oil-fired electrical generating plant in the aquaculture programme at Lorneville, N.B. Based on a feasibility study, a recommendation was made that a commercial plant not be developed there because of high capital and operating costs which would not be offset by market prices. However, interest in the use of thermal effluent for aquaculture continues and the Coordinating Committee is currently promoting the development of a pilot plant to conduct mutidisciplinary studies on the biological, engineering, economic and marketing aspects of production of various promising aquaculture candidates.

Oysters

The five-year oyster (Crassostrea virginica) spatfall monitoring programme to determine commercially reliable spat collection areas was continued for the fourth year. Results show that 1974 was one of the best years to date for commercial size spatfall sets throughout the sampled areas. Spatfall success rates in 1974 were the highest during four years of sampling in both Prince Edward Island and southern New Brunswick; only northern New Brunswick had spatfall success rates below the four-year average figure.

Studies on comparative growth and survival of shellstring oysters reared at various densities were completed. Results showed that growth was retarded on densely set collectors, and there was a wider variation in oyster sizes than on the ones less densely set. There was also a high percentage of poorly shaped oysters on the more densely set collectors. Results indicate that a surviving set of 20 to 25 spat per shell by the first fall is most desirable and, with reasonable maintenance, should yield 10 to 12 well-shaped marketable oysters.

A pilot plant depuration operation for soft-shelled clams (Mya arenaria) in the Annapolis Basin area of Nova Scotia was initiated with limited success. Further pilot plant studies will be conducted in 1975.

The European flat oyster (Ostrea edulis) was introduced to Eastern Canada by hatchery breeding from adults of a Dutch stock held in quarantine in 1969. The final phase of experimental field evaluation of this species is now under way. Stocks of the third hatchery-reared generation are being held under observation in four sites in Nova Scotia and one in Prince Edward Island. The species continues to show great commercial promise. Growth and survival have been excellent. Gonad maturation and spawning appears to be normal and in phase with native molluscan species. Regular histological examination has shown no parasites or disease symptoms.

Heavy metals

Square-foot bottom samples of the invertebrate fauna in the mouth of the Tomogonops River and immediate downstream areas of the Northwest Miramichi were analysed in 1974. Although considerable reduction in heavy metal concentrations in the Tomogonops water has been achieved, Zn^{++} concentrations were of the order of 20 ppb and Cu^{++} of 2 to 4 ppb. Concentrations in the Northwest Miramichi above (upstream of) the mouth of the Tomogonops were less than 1 ppb for both metals. The mean number of invertebrates per square foot in water containing 20 or more ppb Zn^{++} was 32 (range of 13-66) for 7 samples. The mean for water containing 5 to 15 ppb Zn^{++} (N.W. Miramichi immediately downstream of the Tomogonops) was 64 (range of 15-85) for 4 samples. The mean for water containing less than 1 ppb Zn^{++} was 163 (range of 108-188) for 3 samples. All samples were taken from areas of cobble with no large rocks.

Copper, one of the most toxic of the heavy metals, has been tested to determine its toxicity to lobsters and to provide a clue to the sensitivity of lobsters to heavy metals in general. The lethal threshold of copper to lobsters is about 56 µg/l and is not affected by temperature over the range 5 to 13°C or salinity over the range 20-30‰. The time to death at a particular lethal concentration of copper is related to temperature, being twice as long as 5 as at 13°C.

Thallium was detected in the effluents from base metal mines in northeastern New Brunswick and in the receiving waters. The concentration of thallium in the South Tomogonops River was 0.8 to 20 µg/l and the concentrations found in the South Little River ranged from 9 to 88 µg/l.

Thallium is approximately as acutely toxic as copper in soft water to juvenile Atlantic salmon and mortalities were observed at 30 µg/l. In contrast to copper, the LT50 vs concentration curve of thallium does not have a sharp breakoff point indicating an incipient lethal level. The acute toxicity of copper-thallium and zinc-thallium mixtures is not additive. The accumulation coefficient (tissue concentration/water concentration) of thallium in laboratory exposed juvenile Atlantic salmon is somewhat higher than that of copper.

Cadmium levels were determined in the edible portions of lobsters from selected areas picked to sample the bulk of the lobster fishery in the four Atlantic Provinces of Canada. Most of the cadmium in the lobster was in the digestive gland, which is used for lobster paste (tomalley), and ranged from 2.82 to 16.73 ppm while muscle levels were less than 1.0 ppm. Calculated cadmium levels in the total edible portion ranged from 0.51 to 2.98 ppm. It was thought that most of the cadmium was of geologic origin.

A short-term preliminary experiment was carried out to determine the effect of a lobster tomalley diet, with or without added cadmium (± EDTA) as compared with a beef liver diet, on fertilisation capacities of sperm and eggs from brook trout. Sperm from fish on the tomalley diet (3.2 ppm Cd) had the same fertilisation capacity as the fish on the beef control diet. The addition of 10 ppm cadmium to the tomalley and beef liver diets reduced the fertilisation capacities of sperm considerably. Cadmium added to the beef liver diet of mature female fish reduced the viability of the eggs but cadmium added to the tomalley diet of the mature female trout did not appear to have any effect. EDTA added to the beef liver plus cadmium diet of female fish reduced the mortality of the eggs but EDTA added to the tomalley plus cadmium diet of female fish gave the opposite effect.

Work has begun on the processing removal of cadmium from lobster hepatopancreas prior to its incorporation into a lobster paste preparation.

Investigations were carried out to examine the effect of short-term exposure of fertilised herring eggs to cadmium. In these experiments, eggs were able to hatch to what seemed to be morphologically normal larvae but ones that were lacking coordination. However, metabolic studies on these eggs revealed that short exposure to cadmium had a depressive effect on the relative activity of some of the key enzymes involved in carbon dioxide fixation; namely, propionyl Co-A carboxylase and NAD- and NADP-malic enzymes. It is suggested, therefore, that these enzymes may play an important role in achieving the required coordination for the hatched larvae. It is also possible that these enzymes could be used as parameters for early warning of biological damage.

Arsenic levels ranged from 1.04 to 37.29 ppm in fish flesh surveyed but indications are that the arsenic is present in a relatively non-toxic form. The effect of frozen storage and heat treatment on the reduction of arsenate to arsenite has been investigated along with the effects of various known biochemicals on this reaction.

Arsenic levels in lobster digestive gland ranged from 6.61 ppm from specimens obtained from Gaspé, P.Q., to 16.2 ppm in specimens obtained from Sambro, N.S. Little of the arsenic is present as inorganic toxic arsenic.

In vitro studies carried out on the grey seal have shown that certain contaminants (Se, As, PCB, Hg and Cd) affect certain enzyme systems which determine the pathways and end-products during steroidogenesis. Although the steroid analyses are completed, it is necessary to determine tissue concentrations of the contaminants under study in order to associate their concentration with the end results.

A collaborative study with the University of Guelph on the in vivo treatment of harp seals with methyl mercury has just been completed. In two experiments animals received 0.25 mg methyl mercury per kg body weight daily for two and three months, respectively. During the

course of the experiments the animals were under constant surveillance for symptoms of ill health, altered behaviour or eating habits, and a variety of physiological and biochemical tests were done on the animals and on their tissues. Although detailed analysis of the data are still under way, there was a significant decline in steroid production in the treated animals.

The influence of sublethal concentrations of zinc on the growth and biogenetics of Atlantic salmon parr is being investigated. The food intake of parr exposed to zinc and fed to satiation once daily is initially depressed but approaches control levels after 12 days exposure. After day 35, food intake of these fish increases to level 35% greater than controls reflecting an increased energy expenditure. Current experiments are designed to examine changes in the growth rate and proximate body composition of salmon parr exposed to sublethal concentrations of zinc and fed fixed daily rations. Organs of the exposed fish are being examined for zinc accumulation to help explain the observed physiological responses.

Pesticides

Phosphamidon, an organophosphate insecticide used in forest spraying is 50 to 60 times less toxic to lobsters than fenitrothion. The toxicity of phosphamidon is not affected by temperature over the range 4 to 13°C except that the time to death at a particular lethal concentration is four times longer at the lower temperature. The half life of phosphamidon in sea water is reported to be about two weeks. Phosphamidon with lethal threshold of 0.18 µg/l (ppb) and fenitrothion with a threshold of 0.015 µg/l, are potential hazards to lobsters should they reach and persist in the sea.

The olfactory response of lobsters to fish muscle extract was not affected by exposure of a few minutes to phosphamidon at lethal concentrations nor to exposure for 48 hours at concentrations of 0.7 to 1.8 of the lethal threshold. Short exposure to copper at lethal concentrations reduced the olfactory response indirectly by causing avoidance behaviour. Exposure for 48 hours to concentrations of 0.7 to 1.8 of the lethal threshold caused a gradual impairment. The reduced responsiveness of the animals was attributed to disruption of chemoreceptor function. Response returned to normal during 48 hours in clean water. Of three different types of contaminants tested to date, industrial wastes (bleached Kraft mill effluent), organophosphate insecticides, and heavy metals, only copper has been shown to affect olfactory response of lobsters.

When juvenile Atlantic salmon were exposed to sodium pentachlorophenate an anti-fungicide, at a concentration of 50 ppb for 24 hours in order to determine its effect on thermal preference, experimental results showed that the treatment lowered temperature selected from 13.5 to 9.5°C.

The usual analyses of herring for PCB, DDE, DDD, DDT, and dieldrin for the OECD Toxic Chemicals in the Environment Programme were carried out, and the analyses of double-crested cormorant eggs for the same compounds were completed. The results indicate that the environmental levels of PCB and chlorinated hydrocarbon pesticides respond only slowly to the changes of input.

A number of chlorobiphenylols (PCB metabolites) were prepared. Spectral and gas chromatographic properties of these compounds were determined, and a method for the determination of chlorobiphenylols in biological samples was developed. The detection limits for chlorobiphenylols are much higher than those for PCB and chlorobiphenylols have not been as yet detected in environmental samples.

A survey of pentachlorophenol levels in fish from the St Croix and Saint John River Estuary, and in hatchery-reared juvenile Atlantic salmon was carried out. Only very low and probably toxicologically insignificant concentrations of pentachlorophenol (0.34 ng/g wet weight) were found.

In the area of high-molecular-weight chlorinated paraffins, the fractionation of commercial preparation by solvent partitioning was studied. Dimethyl sulfoxide was the best solvent and the fractionations occurred mainly according to the type of the parent hydrocarbon (straight chain, branched, and cyclo-paraffin). In contrast to PCB, chlorinated paraffins are much less, if at all, accumulated by juvenile Atlantic salmon when the fish are exposed to chlorinated paraffin adsorbed on silica, or fed contaminated food, but may be toxic at 10 and 100 g/g food. Chlorinated paraffins are degraded in both aerobic and anaerobic sediments. It is very likely that at production levels comparable to those of PCB, chlorinated paraffins will not cause environmental problems.

Adsorption of C^{14} DDT from sea water by particles ranging in size from bacterial cells to large sand grains is inversely related to mean particle diameter and directly related to concentration if saturation levels are not exceeded. Similar experiments with other organo-chlorine compounds of differing solubility indicate that adsorption is inversely related to solubility.

The levels of DDT residues were determined in three species of euphausiids from the Gulf of St Lawrence. The accumulation of DDT by marine copepods and the possibility that they metabolise DDT has been examined. The effect of DDT on testosterone metabolism in skate is being studied, as is the uptake and metabolism of n-octano-1-^{14}C-hydroxamic acid from water by freshwater maintained brook trout.

A survey of various marine organisms for biphenyl (the simplest molecule of the PCB series) hydroxylating activity has been completed. The experimental conditions for an *in vitro* assay of biphenyl hydroxylating activity in trout have been established with a view to studying how this activity is stimulated by pre-treatment with PCB's.

Oil Pollution

Studies of the effects of the 1970 oil spill in Chedabucto Bay continue. Substantial amounts of oil remain deposited on beaches and in lagoons and continue to contaminate inter- and sub-tidal organisms at certain locations. It will take at least a decade for all traces of oil to disappear.

Three separate sampling programmes which were designed to define background concentrations of petroleum hydrocarbons in the environment were completed. These were studies on the level of petroleum hydrocarbons in the sediments and water column of Come-by-Chance Bay, a preliminary investigation of the levels of petroleum hydrocarbons found around the drilling rigs on the Eastern Canadian Continental Shelf; and the study of background levels along a section of the Northwest Atlantic running form Halifax to Bermuda. Additional improvements in sampling and analytical methods were also reported.

A pilot study on the toxicity and effectiveness of oil dispersants using large outdoor tanks is being carried out in conjunction with the Environmental Protection Service. Work is being completed on the analyses of sediments from the Scotian Shelf and some deep ocean samples for petroleum hydrocarbons. We are also into the second year of a project to determine a hydrocarbon budget for Bedford Basin.

A study has recently been completed on the effects of selected petroleum hydrocarbons on pure cultures of marine phytoplankton. Volume and number of

cells of Dunaliella, Fragilaria, Monochrysis, Skeletonema and Chaetoseras were monitored by Coulter Counter during log phase of growth in the presence of Kuwait crude, Venezuelan crude, of## 2 fuel oil in the ppb range (measured by fluorescence spectroscopy). No significant stimulation or decrease in growth was observed over this period; It is suggested that low levels of these oils have little effect on growth of the algae species studied.

Denmark

(O. Vagn Olsen & P. Johansen)

Denmark

Small scale experiments with the shrimp Leander adspersus have been continued in a closed aquarium system with recirculated water. Hatching and rearing of eggs and larvae have been carried out with success.

Greenland

At Marmorilik, West Greenland, research was initiated on the effect of the disposal of waste from a lead and zinc mine and mill on the marine environment. Analysis for Pb, Zn, Hg, Cd, Cu and Fe have been carried out in sea water, sediments, zooplankton, Fucus vesiculosus, F. distichus, Mytilus edulis, Anarrhichas minor, Reinhardtius hippoglossoides, and Gadus ogac. In addition quantitative investigations were made on the composition of the benthic fauna.

Preliminary results indicate a very heavy contamination of sea water and a very pronounced negative effect on the benthic fauna close to the waste outlet, whereas a few kilometers away from the outlet little or no effect was obvious. F. vesiculosus and F. distichus have proved to be very good indicators of the heavy metal contamination.

Federal Republic of Germany

(H. Mann)

Since 1969 the effects of sulphuric acid and iron sulphate wastes (originating from the production of titanium dioxide) on the benthic macrofauna have been investigated continuously in the discharge area in the German Bight. In addition to population studies, laboratory experiments on the influence of ferric hydroxide flakes on filter-feeding, behaviour, growth, mortality and iron content of mussels have been conducted. Present laboratory studies with Mytilus edulis are set up to investigate the toxicity and accumulation of lead and antimony. Furthermore, the influence of suspended silt and waste products of the asbestos industry on growth and mortality in Mytilus edulis is being investigated. Studies of the fate of organo-halogen compounds in marine organisms and sediments with special reference to accumulation, elimination, transformation in a benthic food chain and in bacteria are continued. Laboratory experiments are under way employing ^{14}C-labelled compounds under conditions similar to those found in the natural environment.

In connection with this programme analytical methods for determination of organo-halogen compounds in North Sea and Baltic animals from different trophic levels are being developed. Residual concentrations in these organisms are evaluated in relation to ecological parameters. The abiotic transformation of organo-halogen compounds in the marine environment was looked into.

Investigations on effects of pesticides on embryonic and larval development of cod, flounder and plaice were continued and extended in order to test toxic effects of DDE in combination with DDT.

Accumulation of Cd was measured in embryos and larvae of the flounder reared in different salinities. Laboratory experiments in order to assess the toxicity of different concentrations of Cd and Pb on the bacteria of the heterotrophic flora of the Weser estuary are under way. In long-term continuous culture experiments the influence of lead on various physiological groups of bacteria occurring in the sediments was tested and accumulation of the heavy metal was determined by means of atomic-absorption-spectroscopy.

In microbiological field studies seasonal changes in standing crop of sewage bacteria, brackish water bacteria, and terrestrial saprophytic bacteria were monitored paying special attention to the influence of man's activities on the Weser estuary.

Furthermore, mention may be made of the studies on fungal propargylies in the Weser estuary, of which the main objects are : development of suitable methods for control of fungal members in estuarine waters and sediments, efficiency tests of these methods throughout the year, isolation and taxonomical identification of the fungi encountered.

New experiments on the effect of mechanical stress on pelagic fish eggs were set up. Other investigations are dealing with the metabolism of euryhaline fish in small containers at different salinities and the growth of salmonids under different environmental conditions.

The investigations on the effect of surfactants on fish and food animals and on the decomposition of the chemicals in seawater at various temperatures are continued. The experiments on tank farming of salmonids in warm water discharged by conventional power plants in the Kiel fjord are continued. Last year's experiments on cage farming of salmonids in combination with mussel culture yielded promising results. Rearing experiments with rainbow trout in cages both in freshwater and in coastal waters of the western Baltic, aiming at the development of optimal trout feeds, were continued.

A great deal of the above mentioned research endeavours was supported and coordinated by the Deutsche Forschungsgemeinschaft.

Finland

(P. Tuunainen & A. Voipio)

Fish Culture

Production of rainbow trout, Salmo gairdneri in net cages in the SW archipelago of Finland has been about the same as reported in 1974.

Some preliminary experiments on rearing Baltic salmon, Salmo salar smolts for stocking purposes, and rainbow trout for consumption in cooling water of electric power plants have been started in 1974.

Marine Pollution

Studies on marine pollution have been continued along the lines reported earlier.

Marine sand and gravel extraction was studied for the Working Group of ICES and these studies have been continued as well.

A quite extensive study on the effects of effluents from the titanium dioxide industry on marine biota and fisheries, started in 1973, was carried through in 1974. This work included among other things studies on the levels of Hg, Zn, Cd, Cr and Sb in Baltic herring (Clupea harengus L.)

whitefish (Coregonus lavaretus. L.), pike (Esox lucius L.), bream (Abramis brama L.), roach (Rutilus rutilus L.), burbot (Lota lota L.), perch (Perca fluviatilis L.) and fourhorn sculpin (Myoxocephalus quadricornis L.)

France

(L. Marteil)

1. Aquaculture

Les travaux entrepris précédemment sur les différentes espèces d'invertébrés et de poissons ont été poursuivis en 1974.

Mollusques. En dehors des études concernant la conchyliculture traditionnelle (huîtres, moules et autres) dont il est rendu compte au Comité des Coquillages, la production de naissain d'Ostrea edulis a été tentée par le Centre océanologique de Bretagne (C.O.B.) en grand volume (20 m^3) et en continu. Le procédé permet semble-t-il un raccourcissement important de la vie larvaire. De même, la production d'ormeaux (Haliotis turbeculata) a été poursuivie avec succès et un essai d'élevage en nature des mollusques produits en 1973 est en cours.

Crustacés. Le développement de la production des post-larves de homard (Homarus vulgaris), en vue du repeuplement des zone côtières, a permis de doubler, de 1973 à 1974, les quantités produites à l'Ecloserie expérimentale de l'Ile d'Yeu avec le concours du laboratoire de Roscoff (Institut des Pêches).

Le même laboratoire a mis au point des procédés permettant d'augmenter le taux de survie des post-larves de la crevette (Palaemon serratus) et de raccourcir les temps d'intermues grâce aux améliorations apportées à l'alimentation et aux conditions de milieu.

De son côté, le C.O.B. a tenté une expérience de production de P. serratus en grand volume (20 m^3); malgré un bon développement larvaire, au moment des métamorphoses, une forte mortalité est survenue pour des causes diverses. Les animaux survivants on été maintenus en prégrossissement à 22° C pendant 2 mois avant d'être mis en élevage en nature où la fin de l'année ils avaient atteint la taille commerciale avec un taux de survie de 33%.

Poissons. Le Centre océanologique de Bretagne a poursuivi les études sur la reproduction en captivité du bar, de la sole et du turbot. Les meilleurs résultats ont été obtenus sur le bar. Simultanément, la croissance et l'alimentation ont été étudiées.

2. Sables et Graviers - (impact sur la pêche)

Dans le cadre d'une étude sur les effets de l'exploitation des sables et graviers marins sur l'environnement et les activités halieutiques, l'Institut de Pêches et le Centre national pour l'Exploitation des Océans se sont associés avec le C.O.B. (Centre océanologique de Bretagne), le CEA (Commissariat à l'Energie atomique) et la Station de Biologie marine de Roscoff pour receuillir le maximum d'informations.

Le programme général ayant trait aux effets sur la pêche a été exposé en avril 1974 au cours de la réunion du Groupe de travail qui s'est tenue sous la présidence de M A.J. Lee, au laboratoire des Pêches de Lowestoft.

A la fin de l'année 1974, on arrive aux conclusions préliminaires suivantes, recueillies sur l'exploitation expérimentale réalisée en Baie de Seine : la seule nuisance de quelque importance pour la pêche constatée dans l'état actuel de nos observations provient de ce que la zone creusée (environ 0.15 km^2 sur une profondeur moyenne de 4 m) est devenue inaccessible aux chaluts de fond. Par ailleurs, en un an d'observations, on a remarqué aucune reconstitution notable du fond. Pour ce qui concerne le benthos, il est bien entendu détruit par les opérations de dragage. Après quelques mois de repos, de nouvelles espèces benthiques ont recolonisé la souille creusée. Toutefois, ce benthos ne forme pas encore une biocoenose équilibrée et l'on ignore encore quelle sera sa constitution définitive.

Il s'agit là de conclusions préliminaires qui devront être précisées dans un an, lorsque ces recherches auront abouti à une connaissance plus approfondie des effets de telles extractions sur l'environnement marin.

Report on Marine Aggregate Production for Year 1974

Country: France

Issuing Authority: CNEXO (Estimations)

Reporting Period (if different from above)

Type of Material	Size Range*	Total Production		Localities
		million m^3	million tons	
Sands	0.063-2.0 mm		2	Manche & Mer du Nord
Gravels	2.0mm - 6.4cm		2	Manche & Mer du Nord
Pebbles/Cobbles	6.4 cm		0.02	Littoral haute Normandie
Calcareous Shell Lithothamnion Other (Specifiy)	All sizes		0.7	Littoral breton

*) The size ranges shown here are idealised, and are intended merely as a guide to the type of categorisation required.

3. Pollutions

Métaux lourds

Les travaux commencés les années précédentes concernant les teneurs en mercure de diverses espèces de poissons capturés au cours des campagnes océanographiques, ont été poursuivis. Ils confirment que les teneurs varient en fonction des espèces et sont plus élevées chez les prédateurs. Ils confirment aussi que les teneurs sont plus élevées en Méditerranée qu'en Atlantique.

Par ailleurs, le mercure et les métaux suivants: Pb, Cd, Cu et Zn on été recherchés dans l'eau de mer provenant de régions littorales bien localisées et à proximité d'estuaires. Comme on pouvait s'y attendre, les teneurs sont, d'une manière générale, notablement plus élevées qu'en haute mer.

Ces même métaux ont été en outre déterminés dans des coquillages (moule, huître) de ces mêmes régions côtières. Les fortes variations des teneurs en fonction des lieux, notamment en mercure, ont permis parfois de remonter aux sources de contamination.

Rejets industriels

Pour compléter les expériences déjà faites en laboratoire, des études de terrain ont été entreprises pour déterminer les effets réels des rejets de fabrication d'oxyde de titane. Ces études seront menées à leur terme en 1975.

Des études similaires ont été entreprises pour suivre l'évolution des zones de rejet de phosphogypse.

Iceland

(I. Hallgrímsson)

Routine hydrobiological surveys were carried out in Icelandic waters covering nutrient, oxygen, primary production and zooplankton studies.

Studies on mercury concentrations were made in sea water and in the brain and liver of young seals. This programme will be continued.

Ireland

(F. A. Gibson)

Pollution

Pollution studies were continued in 1974 along the lines reported for 1973. A spill involving 600 000 gallons of crude Kuwait oil caused by an error during loading procedures occurred in Bantry Bay on 10 October 1974. A combination of mild bright calm weather, a gentle north-westerly airstream and neap tides, combined with extensive recovery of crude oil, minimised the shore area affected by the spill and kept mortality amongst the flora and fauna to a minimum. Studies of the ecosystems of Bantry Bay will be intensified in 1975 and 1976, in an effort to follow up the long term effects arising from the spill.

A hydrographical survey was made over an area of some 50 square miles (130 square kilometres), outside the territorial limits south of Cork Harbour. The rapid industrialisation of Cork Harbour calls for a minimisation of the rate of discharge into the Harbour waters. At present the alternative is to dump permissible effluents into offshore areas. This is considered as an intermediate step whilst new methods of treatment, or recycling or making suitable alternative uses of wastes are developed. Irish industrial concerns are aware of the recommendations being made to alter the general pattern of waste disposal and many of them have expressed their strong desire to adopt alternative and safer methods of disposing of wastes.

Fish transplantation and cultivation

Mussel transplantation from sea areas to estuaries was continued in 1974. Experiments with methods to assist the settlement of naturally fertilised oyster "spat" were continued. However, in 1974, Ireland experienced one of the coldest and inclement summers on record. Accordingly, for the first time since 1970, and for only the second time in 16 years, Tralee Bay oysters failed to have a successful spatfall in 1974.

At the Marine Station at Carna, County Galway, on the extreme west coast of Ireland, larvae of Crassostrea gigas and Ostrea edulis were produced in limited quantities. Other species spawned in captivity including Venerupis decussata. Also attempts were made to complete the cycle of the veliger of Pecten maximus under laboratory control.

At the Salmon Research Trust, Traenlaur, County Mayo, arrangements were completed for the study of salmonid rearing in saltwater tanks. Experiments were carried out by the Irish Sea Fisheries Board into the feasibility of rearing salmon smolts in nets and in the sea and similar experiments were undertaken by the Electricity Supply Board in a quiet inlet. Both experiments are on-going.

Netherlands

(P. Korringa & J. Duinker)

No significant improvement in the state of pollution of the Dutch coastal and inland waters could be recorded for the year 1974. The studies on heavy metals in fish focussed on cadmium, mercury and lead. Only in the case of mercury, fishery products contribute materially to man's daily intake of these heavy metals. The amount of mercury present in fishery products - on an average 0.1 ppm - warrants, however, that the mercury intake from fish remains, even for extreme fish eaters, far below the safety level established by the FAO/WHO.

Of the numerous xenobiotic compounds introduced into the environment by man, especially the organohalogene compounds are the ones which give reason for concern for the Dutch fishery. Above all, the bio-accumulate toxic and persistent members of this group are the ones which should be considered as dangerous from a public health point of view, e.g. PCB's, DDT and other pesticides. On the other hand, compounds such as endosulfan and PCP should be considered to be a threat to the fish stocks as such. No reduction could as yet be detected in the high level (20 ppm on a lipid base) of PCB's contamination of fishery products from Dutch coastal and inland waters.

Attention has been paid to several parasitological and pathological topics : in plaice the study of the occurrence of the micro-organisms Glugea stephani, Myxobolus aeglefini and the Lymphocystis virus was continued; in post larval herring a study of parasites led to preliminary results; in several species of marine and fresh water fish the occurrence of parasites, especially nematodes, was recorded. A special study was made of a disease raging in flat oysters in France, which might threaten the Dutch oyster industry. Seed oysters imported from France were checked for the presence of parasites and compared with truly Dutch stocks. Although infected oysters were found among the imports, no clear cases were found of fatal further development of the disease in the Dutch oyster district in 1974.

Results of investigations carried out in the Netherlands Institute for Sea Research have shown that trace metals and chlorinated hydrocarbons can undergo chemical and physico-chemical changes after deposition of particulate matter in bottom layers in the Waddenzee area. Hence, pollutants transported and deposited in particulate state can be mobilised into the interstitial water from where they may enter the overlying water in the dissolved state.

Norway

(G. Berge)

Pollution

1. Investigations on the pollution of selected Norwegian fjords were carried out in May. The fjords selected represented different types of industrial loads. Measurements were made of salinity, temperature, primary production indices, nutrients and oxygen distribution, turbidity, particulate matter and polycyclic aromatic hydrocarbons in sediments, PCB and DDT in fish (Institute of Marine Research).

2. The inter-institutional study of biological and other aspects of planned nuclear power plants in south eastern Norway continues. A programme covering baseline studies of fish and shellfish productivity in the Oslofjord and adjacent coastal waters, experimental investigations of thermal influence on biological processes and possible utilisation of heated effluents for fish cultivation are carried out by the Institute of Marine Research, Biological Station Flødevigen. Specific biological programmes related to plant production and composition (attached and free-floating algae) were carried out by the Norwegian Institute of Water Research (NIVA), and the physical programmes by the Waterways and Harbours Laboratory. The results so far have been reported, and a joint case study based on those results is in preparation. Additional programmes to be carried out during 1975 are initiated, and studies also expanded to cover selected areas at the western coast of Norway.

3. Monitoring programmes. Hydrocarbons from oil in sea water. Gaschromatographic analysis of monthly samples from depths of 0, 10 and 50 metres from a permanent section between Norway and Shetland and twice yearly sampling in the central North Sea circling the oil fields (Institute of Marine Research). The programme is coordinated with British studies on hydrocarbons in fish and sediments and is further part of the ICES monitoring programme.

Heavy metals in fish and shellfish. Stocks of commercial fish are continuously being analysed on mercury, cadmium, zink, copper and lead at the Official Norwegian Quality Control Institute for Canned Fish Products. Involved in this monitoring are also the Directorate of Fisheries, Institute of Technical and Chemical Research, and the Institute of Hygiene of the Norwegian Veterinary High School. Results are made available to the Institute of Marine Research.

Heavy metals in sea water and mussels in polluted areas. Analysis of samples from selected fjords are being made on Fe, Zn, Cu, Cd, Pb and Hg at the University of Oslo, Institute for Marine Biology and Limnology. The programme is part of the ICES monitoring programme for 1974.

4. Organic pollutants in coastal sea water. This programme continues for the third season. The organic load of the Baltic Current is being investigated from the Øresund, through the Kattegat, Skagerak and along the western Norwegian coast. Continuous measurements are made on particulate matter, organic components, nutrients and temperature, whereas primary production indices are measured at regular intervals (Institute of Marine Research).

5. Bioassays. The effect of low concentrations of EDC-tar on microorganisms was studied together with the degradability of this matter in natural sea water. Accumulation experiments were carried out with this matter on fish, lobster, mussels (Institute of Marine Research).

6. A programme studying the influence of various concentrations of pollutants on the biology of Pleuronectes flesus was initiated in the Oslofjord in 1973 (University of Oslo, Institute of Marine Biology and Limnology). The programme is part of a joint Scandinavian effort aiming at a development of an early warning system.

7. The eutrophication of the Oslofjord caused by domestic sewage is continuously being watched by the University of Oslo, Institute of Marine Biology and Limnology.

8. The Norwegian Institute of Water Research, NIVA, has been assigned by several industries and municipal authorities in discharge problems of different water systems including fjords. NIVA is further conducting baseline studies of heavy metals and studying potential growth in natural and polluted aquatic systems (including fjords).

9. The programme on recording captures of dumped containers and their contents is continued. Resulting from these observations, regulations of handling such findings have been worked out by Norwegian Health Authorities in cooperation with the Director of Fisheries.

10. A programme on surface water drifts around the North Sea oil fields continued. Plastic envelopes were every second week released from Ekofisk platforms and surface (Institute of Marine Research and Norwegian Continental Shelf Office).

11. Polycyclic aromatic hydrocarbons, originating from heavy industries using the Søderberg electrode, were analysed in sediments from fjords in Western Norway. The distribution pattern showed that these pollutants were mainly trapped in the fjord sediments. (Institute of Marine Research).

12. As part of a monitoring study of the fjords round Bergen, samples of benthos and plankton within a radius of about 30 km from the city have been taken and analysed. Some faunal effects attributable to pollution can be detected in the parts of the area closest to Bergen, but the principal use of the results is seen as recording the situation as it was in 1974, for future reference. (Biological Station, University of Bergen).

13. Investigations on the use of brown seaweeds as indicator organisms for monitoring of heavy metals in the marine environment (Institute of Marine Biochemistry).

14. Development of dialysis culture equipment for bioassays of pollutants. (Institute of Marine Biochemistry).

15. Monitoring of fjord waters with respect to heavy metals and hydrocarbons by means of dialysis cultures of phytoplankton (Institute of Marine Biochemistry).

Poland

(J. Wiktor and W. Ślączka)

In the field of mariculture the investigations on feasibility of fish eggs hatching and rearing of fish in early stages of their development in brackish water (7 to 10‰) were continued. It was found that it is possible to incubate the fish eggs of winter and spring breeds of rainbow trout (Salmo gairdneri) as well as of sea trout (Salmo trutta) in such water. In the case of both species mentioned, fertilisation has to take place in fresh water. On the other hand, fertilisation and the ensuing

incubation of migrating Coregonid (Coregonus laveratus) and pike (Esox lucius) run smoothly in brackish water.

The environmental conditions described accelerated breeding of fish in their early stages of development and increased their feeding intensity.

The investigations will be continued and elaborated in 1975.

Baltic Pollution

The investigations were carried out by means of the Polish research vessels "Hydromet", "Birkut" and "Imor", covering the Baltic proper, the Danish Sounds and the Finnish Bay (20 stations, once per year), Polish coastal waters (26 stations, 4 times per year), and Gdańsk Basin (40 stations, 12 times per year). For investigations in shallow inshore waters small vessels and motor boats are used. Samples of sea water, sediments and biological material (benthos, plankton and sometimes fish) were collected. In addition, Baltic fish were sampled from local fishing boats, North Sea and Atlantic fish from trawlers.

Some investigations were carried out on board research vessels, others in laboratories ashore. The investigations deal with such pollutants as heavy metals (mainly Hg), chlorinated hydrocarbons (mainly organochlorine pesticides and PCB's), mineral oil hydrocarbons and detergents. For eutrophication studies the nutrient salts are measured in sea water.

The Polish work on the Baltic pollution problem is divided into :

a) research work,

b) technical work,

c) control work

d) administrative work.

Research Work

This work covers all investigations which are connected with the pollution of the Baltic Sea. It includes chemical, physical and biological investigations.

Main research problems are :

a) Estimation of contents of pollutants mentioned above in sea water, sediments and biological material.

b) Horizontal and vertical migration of pollutants in offshore and in open sea waters.

c) Inflow of pollutants through rivers and atmosphere.

d) Exchange of pollutants between atmosphere and surface layer of sea water.

e) Estimation of radionuclides in the marine environment.

f) Elaborating new analytical methods for quantitative and qualitative analysis of harmful compounds in marine environment.

g) Biodegradation of some toxic compounds by marine organisms (mainly by bacteria).

h) Self purification of the marine environment by marine organisms.

i) Bioaccumulation of some pollutants in the food chains of the marine environment.

j) Influence of selected toxic compounds on marine organisms.

k) Investigations with test organisms of marine origin.

Technical work includes two main problems :

a) Prevention of the inflow of harmful substances into the marine environment from rivers, harbours, industrial plants and vessels.

b) Removing mineral oil from the surface of sea water.

Control work includes estimation of chlorinated hydrocarbons, mercury and radioactive pollution in commercial fish, and estimation of the hygienic state of offshore waters, especially in the vicinity of towns and in health resorts. The inflow of pollutants through rivers and atmosphere is also under permanent control.

International work includes:

a) Participation in the work of the Interim Commission of the Helsinki Convention.

b) Participation in the Baseline Sampling Programme of the ICES/SCOR Working Group on the Study of Pollution of the Baltic.

c) Participation in the intercalibration work of chemical analysis of pollutants which is carried out by the Baltic countries.

The main research centres which conduct the investigations on the Baltic Pollution Problem are :

a) Maritime Branch of the Institute of Meteorology and Water Economy in Gdynia;

b) Sea Fisheries Institute in Gdynia;

c) Maritime Institute in Gdańsk;

d) Institute of Hydrotechnics in Gdańsk;

e) Oceanologic Station of the Geophysics Department of the Polish Academy of Sciences in Sopot;

f) University of Gdańsk;

g) Medical University in Gdańsk;

h) Technical University in Gdańsk;

i) Technical University in Szczecin;

j) Argricultural Academy in Szczecin;

k) Maritime School in Szczecin;

l) Sanitary Service.

Portugal

(M.J. de Figureido)

A programme was started late in 1974 to assess the water quality in aquaria provided with biological filters, and its suitability for crustaceans and fish rearing in recirculating water. Samples were taken twice a week to determine the factors oxygen, pH and salinity and to measure the nutrients nitrites, nitrates, phosphates and silicates. Simultaneously some bacterial aspects, such as total number of bacteriae, were studied.

Cultures of herbivores were kept and developed during 1974. Copepods of the genera Calanipeda, Tisbe and Cletocamptus were cultivated in static and in recirculating water, under identical conditions of luminosity and temperature.

Mixed cultures of the rotifer Brachionus plicatilis and the copepod Tisbe sp. have been reared using different types of food and air supply. The phytoflagellates Tetraselmis suecica, Platymonas sp. and Nannochloris sp. were tried as food, and the best results (190 Brachionus/ml) were obtained with Tetraselmis. Accordingly, cultures of these phytoflagellates have been developed in order to attain optimal concentrations.

Determinations of bacteriological pollution in oysters and water of the Estuary of the River Sado have been carried out during spring and summer 1974.

Spain

(M. Torre)

Research was carried out on water pollution in the Bay of Palma de Majorca, produced by city sewage. Special attention was paid to the effect of eutrophication, showing a zonation in relation to the intensity of the influx of sewage.

A study on sewage pollution in Mahon Harbour was started in the autumn of 1974. Parameters to be studied are : chlorophyll distribution, phytoplankton and zooplankton composition, nitrites, nitrates and phosphates, dissolved oxygen, and E. coli and Streptococcus fecalis distribution.

The study on the sulphur content in the bottom deposits of the Ria de Pontevedra was continued.

The comparative study on atomic absorption and flame photometry to evaluate the lithium content in sea water, and its application to the Ria de Arosa, was completed.

Tests on artificial feeding in the clam Venerupis decussata kept in aquaria were carried out.

Tests were made on artificial substrates for the setting of red alga Gelidium sexquipedale.

Work on hatchery rearing of O. edulis, V. decussata and V. pullastra was continued, leading to satisfactory results.

Sweden

(H. Ackefors & B.I. Dybern)

Baltic Sea

Off-shore investigations are carried out concerning physical-chemical, biological and toxicological studies. Physical-chemical investigations embrace temperature, salinity, oxygen, hydrogen-sulphide, pH, nutrient salts. The biological investigations embrace primary production (^{14}C-technique), phytoplankton for qualitative and quantitative analysis and for chlorophyll a and chemical analysis of C:N:P, secondary production of zooplankton and microzooplankton and investigations concerning macrobenthos. Cod, herring, plaice and flounder have been collected for analysis of chlorinated hydrocarbons and heavy metals. Regional and local investigations concerning the effects of sewage water discharge, industrial waste and warm water discharge from power plants.

4. Special investigations have been carried out in connection with present and future warm water discharges, e.g. at Forsmark and Oskarshamn-Simpevarp.

5. Sweden and Finland have started a common programme for investigations in the Bay of Bothnia.

United Kingdom

1. England

(A.Preston)

1. Fish Cultivation - Fisheries Laboratory, Lowestoft

Turbot

Larval rearing

Earlier successes with larval turbot were achieved by using large rearing tanks (from 5 000 l). Survival was poor, for reasons not fully understood and difficult to explore without massive facilities. Trials of smaller systems were therefore undertaken:

a) large tanks with *in situ* production of algae and rotifers;

b) as a), but with larvae held in suspended chiffon cages (60x30x30 cm);

c) small tanks (300 l) with *in situ* production of algae and rotifers;

d) small tanks (300 l) incorporating biological filters with larvae retained in chiffon cages;

e) small tanks (30 l) with added rotifers and mussel larvae.

All five systems produced metamorphosed fish with best survivals of 2% - 6% in b and e. One late trial under system b, using turbot/brill hybrids, produced 50% survival to late stage 4.

Early feeding on rotifers now appears to be easy to achieve and mortalities occur mostly during the period after weaning onto *Artemia* nauplii. Studies of gut contents, however, revealed that turbot/brill hybrids feed much more heavily on rotifers than do turbot and have a much better survival. It remains possible therefore that the initial feeding level in turbot is still inadequate.

Studies of gut contents also revealed an association between larval pigmentation and feeding rate; heavily pigmented (black) larvae had less food in the gut than the more lightly coloured (brown) individuals. Colour was reversible and dependent on background - black on light background and brown on dark.

On-growing

0-group turbot were grown in a closed circuit system of 4 000 l capacity. During 10 months growth at 12°-15°C, mean weight increased from 5.7g to 214.6g with 98% survival. Final loading of the system comprised 40 kg fish.

3-group turbot reared from 0-groups on a diet of trash fish matured satisfactorily and produced good quality eggs after one year at ambient temperature levels.

Sole

Over 20 000 metamorphosed sole were produced, 95% of which were normally pigmented. Further work with this species is deferred pending progress towards a solution of the feeding problemsassociated with the on-growing phase.

Halibut

Fertile eggs were received from Canada and Norway. No larvae survived beyond 5 days after hatching.

Males in a resident spawning stock matured for the second year. One female ovulated in May 1974, another in November 1974 and several females produced eggs in February 1975. A hatchery programme is in hand.

2. Fish Cultivation - Fisheries Laboratory, Port Erin

Turbot

Larval rearing

Survival from egg to metamorphosis was poor, only 190 fish were reared beyond metamorphosis. The value of the presence of algae during the rotifer feeding stage was confirmed for turbot and lemon sole. Fish of the latter species which had received rotifers without algae showed a poorer growth rate after metamorphosis when compared to fish which had received rotifers plus algae. This demonstrates the potential long term effect of differences in food quality in early larval life.

Artemia metanauplii, used as food for late stage turbot larvae, have been reared to maturity in about 14 days at 24°C on a diet of bakers yeast, using 50 l vertical columns and continuous water circulation.

Juvenile studies

Growth was depressed when pCO_2 increased above 10-13 x 13^{-3} atm., giving a pH of below 6.8-6.7. Nitrite nitrogen concentrations up to 23 mg/litre had no effect on growth. In freshwater, salmon and trout are killed at levels below 1 mg nitrite-nitrogen/litre.

Dover Sole

Weaning of 20 mm sole onto a sieved dry particle gave variable mortality, 25-89%, and poor growth. Weaning onto a paste of homogenised frozen mussel gave lower mortality 18-23% and better growth. All subsequent feeding has been with moist pellets of 40% water content based on dry powdered constituents. These have given growth rates of 0.6-0.7 mm/day on diets ranging from 100% mussel to 50% mussel, 50% fish. This compares with growth rates of 0.7-0.9 mm/day for fish of similar size feeding on Lumbricillus.

Disease studies

Turbot larvae showed an increased incidence of Vibrio prior to mortality. Histological examination showed large numbers of bacteria in the gut and degenerative changes in gut epithelium. The incidence of hepato-renal syndrome in juvenile turbot was about 30% and was unrelated to diet, water content or feeding level. The condition has also been noted in Dover sole and possible causes are being investigated.

3. Marine Pollution - Fisheries Laboratory, Burnham-on-Crouch

Monitoring Investigations

The twice yearly sampling and analysis programme for cod, whiting, plaice, herring and mackerel from 9 ports around England and Wales was maintained.

As an extension of this study a method has been developed for routine analysis of arsenic in fish and shellfish and the method has been used on some of the routine samples as part of a survey of arsenic levels in fish and shellfish from around the United Kingdom. Further improvements have been made in the method used for mercury and most of the sources of error have been eliminated. The method has been described in detail and is intended for publication.

The results of the entire monitoring operations 1971-1973 inclusive have been compiled and a report prepared for publication. In the course of the compilation it became apparent that the non-routine sampling has been very scattered and has sometimes borne little relationship to the areas which are most important in terms of known inputs of pollution or quantities of fish caught. As a result plans are now in preparation for a substantially increased monitoring programme taking account of these needs. Most major fishing areas will be sampled and particular attention will be paid to the North Sea area. Attempts will be made to link the programme with the sea water sampling and analysis programme of the Lowestoft Laboratory.

Dinoflagellate toxicity

Annual monitoring of the north-east coast of England for the presence of dinoflagellate toxins in mussels continued. Regular weekly samples were collected from the north-east coast between March and August. Of 122 samples examined, 10 yielded detectable toxicity. Toxicity first appeared at Berwick in mid-May and was still evident at Sunderland and Hartlepool at the end of June. With the exception of two samples taken at Hartlepool in June which contained 1 130 and 2 730 mouse units (m.u.) of toxin/100 g shellfish all toxic samples remained below the safe limit of 400 m.u./100 g.

No blooms or unusual biological events were recorded in the area during the year and phytoplankton analysis of mussel guts did not reveal large numbers of dinoflagellate. Toxicity at Hartlepool and Sunderland was associated with the presence of Gonyaulax tamarensis (excavata?) and Gonyaulax sp. in numbers not less than those found elsewhere; at Berwick Peridinium sp. was dominant when toxicity was detected in mussels.

With the suggestion that the toxic form of Gonyaulax tamarensis should now be called Gonyaulax excavata it is planned to send representative samples of phytoplankton from the 1975 programme to the USA in order that a more precise identification can be made.

Ecological investigations

a. Wastes dumped at sea

With the passing of the Dumping at Sea Act (1974) the Ministry of Agriculture, Fisheries and Food has assumed statutory control over the disposal of wastes by dumping around the UK coast. The suitability of proposed and existing dumping grounds and the effects of waste disposal on the fisheries and general ecology of the area have been investigated. The magnitude and difficulty of the task has resulted in the Burnham-on-Crouch Laboratory giving much attention to the problem over the past year and the development of a rapid assessment approach.

The aim is to undertake a synoptic survey of the area and to gain as much information on various aspects of the area as possible in the limited time available. The nature and extent of a field investigations depends upon the precise area in question, its fisheries and the waste it is receiving. However, much of the emphasis of the investigation remains on assessing the status of the benthos (both in-fauna and

epifauna) in relation to the sediment types present. However, instead of detailed laboratory identification, the fauna is analysed, as far as possible, on-board and only sediment samples are returned to the Laboratory for particle size/organic analysis.

It is possible by this method to determine the main faunal components and communities, and so allow comparison with future years and for gross changes to be detected.

The other important aspect of these synoptic surveys is the collection of fish, benthos and sediments from the vicinity of the dumping grounds for chemical analysis in order that the possible accumulation of persistent substances may be monitored.

Using this general approach the major dumping grounds around England and Wales have been surveyed during the past year to determine the distribution of sediments and benthos and their metal content. Variations on this basic approach will be employed in future years to supplement and extend original surveys.

b. Gravel extraction

During the past year a study has been initiated to determine (i) the importance of the benthos as fish food in an area of gravel substrates and (ii) whether any change in species composition or abundance of these animals caused by gravel extraction is likely to result in changes in the acceptability of the area as a feeding ground to various species of fish. Distinction has been made between sedentary animals that live in the sediment (in-fauna), whose recolonisation will be dependent mainly upon recruitment of larvae from outside populations (colonisation by these animals is therefore likely to be relatively slow) and mobile surface-living epi-fauna; the migration of the latter into a dredged area may be the means of more rapid recovery. Similar distinction will be made between fish species that feed mainly on epi-benthic fauna and those that take mainly in-fauna.

During the past year, the distribution and abundance of the resident epi-fauna and in-fauna in an established dredging area and in a nearby control area has been determined quantitatively by grabbing and beam trawling. This sampling programme will continue once intensive dredging commences in order to determine its effects and the rate of recolonisation of the various components of the benthos.

Steps have been taken to comply with the request of the Working Group on "Effects on fisheries of marine sand and gravel extraction" to provide information on an annual basis on marine sand and gravel extraction in their sector.

LABORATORY INVESTIGATIONS

a. Toxicity tests

The biological assessment of industrial wastes intended for disposal at sea has continued to be based on a routine bioassay technique in which the incipient lethal concentration of the waste to brown shrimp (*Crangon crangon*) and to the armed bullhead (*Agonus cataphractus*) is calculated. These routine tests for acute toxicity have been supported by experiments to determine the influence of different testing procedures on the lethal concentration, to measure the susceptibilities of shrimps of different sizes and the relative susceptibilities of different test species. Attempts have been made to predict the toxicity of mixtures of wastes from the toxicity of the

individual components. These results and those of similar experiments have, in conjunction with field observations, made it possible to define more precisely the discharge requirements for the disposal vessel.

b. Uptake studies

Considerabe effort has enabled the UK to make significant contributions to the Working Group on degradability of organohalogens set up under the auspices of the Oslo Commission. Measurements of bioaccumulation of pentachloroethane, pentachlorobenzene and dieldrin from sea water by shrimps, mussels and fish have enabled accumulation factors for these compounds to be calculated. Similarly, their biological half-lives have been determined from loss experiments. The importance of the length of the exposure period, the concentration of the compound in sea water, the size and condition of the test organisms and the test species, in determining the values of accumulation factor and biological half-life have been assessed.

c. Long-term sub-lethal studies

An increasing amount of attention is being given to determining sub-lethal responses of animals to pollutants. A detailed literature survey of previous studies has shown that most methods are inappropriate because it is not possible to assess the significance of the sub-lethal response. Preliminary experiments have shown that Crepidula fornicata may be fed cultured algae and that growth and reproduction will take place in the laboratory. The effects of low levels of selected pollutants on the ability of Crepidula populations to maintain themselves over several generations in the laboratory are now planned.

OIL POLLUTION STUDIES

Oil pollution research continues to occupy a great deal of time and, as exploitation of the North Sea gains momentum, an increasing amount of time is being spent in giving advice on the fishery and ecological implications of this development.

a. Improved tests of toxicity

The major practical effort this year has been devoted to the development of an improved technique for assessing the toxicity of oils, oil dispersants and oil/dispersant mixtures. These substances are very difficult to test because they frequently contain immiscible components and in a standard static test tank much of the material under test remains at the surface of the seawater and therefore not in contact with the test animals. To compare the toxicity of such substances in a meaningful way, it is necessary to constantly agitate the test solution and so obtain a dispersion of similar sized droplets throughout the water column of the test tank.

A system has now been developed that satisfies these requirements and it is now being used to assess on a routine basis the toxicity of oil dispersants in conjunction with oil. An indirect drive mechanism for the stirrer system has also been developed to allow experimental tanks to be sealed to overcome problems posed by the volatility and flammability of some types of oil.

Another test is being developed to simulate the use of oil dispersants on beaches in order to determine which are most suitable for use under such conditions.

b. Field investigations

In cooperation with Scottish and Norwegian fishery laboratories further cruises have been carried out in the North Sea in areas of oil exploitation; samples of sediments, benthos and fish have been obtained for hydrocarbon analysis. To obtain greater understanding of the results of such studies a programme has

been initiated to investigate the fate of various petroleum hydrocarbons within an estuary receiving known amounts of refinery effluent. It is intended to establish the pathways by which certain petroleum hydrocarbons are incorporated into marine sediments and organisms, and to attempt to construct a budget for the turnover of these hydrocarbons within the estuary. So far only preliminary surveys of the area have been completed; during 1975 the composition of the effluent will be monitored regularly and samples of water, sediments and organisms collected for hydrocarbon analysis.

MICROBIOLOGICAL INVESTIGATIONS

a. Shellfish purification

Development of high density purification plants for the removal of faecal bacteria from bivalve molluscs has continued. In an attempt to reduce construction cost for the small operator, cheap do-it-yourself u/v units have been developed and tested under commercial conditions. Four new plants of the stacked tray, high density type and two conventional open tank systems have been designed and tested and are now operational In addition one mussel system using chlorination has been successfully converted to u/v. Work is now underway to improve water quality in high density systems using biological filters.

b. Coliphage studies

Considerable effort has been directed towards an investigation of the potential of coliphage (bacterial viruses) as an indicator of sewage pollution in shellfish & shellfish-growing waters. The effects of various parameters including salinity, pH, light and nutrients on survival of phage have been determined in parallel with similar observations using E. coli. Results suggest that phage are more persistent in water than existing bacterial indicators and may have a value in assessing risks from enterovirus to which they bear some resemblance. In 1975 a study of enterovirus in sewage and waters will be started and the relationship between phage and entervirus will be examined.

c. Vibrio parahaemolyticus

During 1974 many shellfish samples (crustaceans and molluscs) have been examined for the presence of Vibrio parahaemolyticus following the first recorded outbreak in Britain of illness due to this organism. Only two positive isolates were obtained, both from crabs taken on the Essex coast. A number of laboratories, particularly those of the Public Health Service, have shown that Vibrio parahaemolyticus occurs naturally in a number of areas in sediments, water and shellfish. In an attempt to determine the natural distribution of this organism in British coastal waters, the work of all these laboratories has been coordinated and a survey is being made for a period of one year, of water, sediment and shellfish samples.

2. Scotland

(A.D. McIntyre)

1. Food Chain Investigations

Studies of plaice nursery grounds in the Firth of Clyde were continued in 1974, when the carrying capacity of various areas was assessed and attempts made to relate this to the physical and biological characteristics of the grounds.

The use of experimental ecosystems in the formof large plastic bags approx-3 m in diameter and 20 m deep, was extended, and as a preliminary to experiments with fish larvae, a study was made of phytoplankton - grazer - pre-

dator relationships in the system.

2. Shellfish Cultivation

Hatchery-reared seed of native (Ostrea edulis)and Pacific (Crassostrea gigas) oysters and naturally-settled spat of scallops (Pecten maximus) and queens (Chlamys opercularis) were grown under a variety of conditions in five west coast lochs. Oysters grew and fattened well in Loch Ardvar both low on the shore and suspended from a raft, but the best growth was in Linne Mhuirich (Loch Sween), where C. gigas attained a mean weight of 68,3 g, commercial size, in 16 months.

Initial losses of 8-10mm (0.1g) seed of both species of oyster were large, but were low after the first three months. Smaller seed, 2-3 mm (0.01 g) of C. gigas showed a higher initial survival.

Queens attained commercial size, 55-60 mm in two years, but scallops, after growing well in their first year, grew poorly in their second.

Survival of both species has been generally good, but high mortalities in some situations were probably caused by reduced salinity.

3. Fish Farming

Disease and parasite studies

A programme of examination of the parasitic fauna of young cultivated salmon at Almondbank continued and was extended to wild fish in the same area and to a commercial hatchery near Montrose. Comparison of Almondbank fish showed increased protozoan and decreased metazoan numbers in the cultured fish. Of the metazoansonly the digeneans with a free swimming stage were present in significant numbers in these fish. With the possible exception of the ectoparasitic protozoan Epistylis it was considered none of the parasites was present in significant numbers to cause harm to fish. In October papillomatosis, a proliferative epithelial skin condition possibly comparable to warts in humans, was observed in 52% of examined fish. In the commercial hatchery the spectrum of parasites was quite different due to the regular monthly intrusion of seawater into the freshwater supply. The common ecoparasitic ciliates were almost absent, some marine parasites were in evidence.

Immunisation of salmon and trout has demonstrated that variability of response is not uncommon and that the complexity of nature of the antibodies requires further study. The concluding work on the immune system in plaice has shown that small amounts of specific antibody are formed in 4-6 days, a potentially important result in studies of immunising regimes in farmed fish. The finding of antibody on the surface of lymphocytes of the plaice, and the "ringing" and "capping" behaviour of specifically stained preparations of lymphocytes demonstrates the essential similarity of many aspects of the lymphopoetic system of fish with higher vertebrates.

A potent and previously undescribed toxin of Aeromonas salmonicida, the causative organism of furunculosis, has been demonstrated and partially purified. The failure of previous attempts to protect salmonids from furunculosis may stem from an incomplete appreciation of all the antigen factors necessary for protection.

The low levels of IPN virus infectivity in experimental culture have been improved by successive passage at low multiplicity of infection, however the results imply the presence of significant quantities of defective interfering virus particles. The current quantal assay procedure has been found to lack precision and other alternatives

are being pursued. The survival of IPNV has been shown to be particularly sensitive to initial temperature treatment and to the temperature of storage infectivity of virus being continually lost at -20°C but remaining constant after an initial drop at -7°C and -160°C.

Surveys of wild fish in the watershed of an infected farm shows the continuing presence of virus in juvenile and wild fish only in a highly restricted area close to the farm. Proof of the independent establishment of IPNV in wild fish can only be obtained from evidence of the continuing spread of virus beyond the vicinity of the farm and this is lacking at present.

During this year 18 fish farms were tested for virus disease and the presence of IPNV strain Sp was shown in 5. One infected farm has since closed and other 4 either have or are in the process of having IAO's laid on them. Of 37 requested visits to 20 farms a total of 355 fish were examined. Two cases of IPNV and 9 of furunculosis were found. Some 144 specimens of wild salmonids were submitted for examination. There were 8 cases of furunculosis and 24 of UDN.

Monitoring of the WFA turbot and to a lesser extent sole stocks continued at Hunterston and Ardtoe. A coccidean similar to the Toxoplasma group, associated with tumor-like cysts found throughout the body of 2 year old turbot caused widespread infection. The previously reported positive association of Myxidium incurvatum and Rhabdospora thelohani with liver and kidney lesions (hepeto-renal syndrome) was shown to exist in wild fish from Welsh and Scottish beaches as well as in both farms. Rhabdospora infections alone were demonstrated in artificially reared turbot 17 days old at Ardtoe and in artificially reared juvenile sole at Hunterston.

The incidence of larval nematodes in cod showed similar or increased levels in 1973-4 mostly due to Anisakis in North Coast and Moray Firth stocks. The incidence in herring in different fishing grounds was similar to previous years. Experimental infections of cod with 3rd stage larvae of Porrocaecum was demonstrated indicating that in nature similar transmission may occur in 3 out of 903 specimens of Thysanoessa inermis for the North Minch, a new host and locality record.

Salmonid cultivation

The two DAFS laboratories, the Marine Laboratory and the Freshwater Fisheries Laboratory have embarked on a wider programme of research into problems of fish farming grouped under the above project title. New facilities to allow these investigations of the rearing of salmon and rainbow trout in fresh and sea water will be phased into operation during 1975-7. Workers from other UK laboratories will also participate to achieve maximum use of the facilities and rapid investigation of priority areas.

4. Pollution

Shellfish and public health

The laboratory continues to maintain a service for advice on purification and to analyse shellfish and water for indicators of faecal pollution and paralytic shellfish poisoning.

Firths of Forth and Clyde

As sites of increasing industrialisation, these areas have been selected for special study. In the Clyde further hydrobiological surveys were carried out to provide data on levels of pollutants and their dispersal, while on the sewage sludge dumping ground studies were made of the deposition

rate of the sludge and of its effect on the feeding of copepods. Experimental work in this area included a continued examination of the effects of water from several regions of the Clyde on the development and survival of herring eggs and larvae, and the results in 1974 indicate that important variations take place from year to year in the quality of water in a given region and emphasises the importance of understanding these variations in making stock recruitment assessments.

In the Firth of Forth, intensive inshore surveys were made at sites where coal wastes have been dumped on the foreshore or into the sea, and samples taken to assess the spread of these wastes.

Experimental work at Loch Ewe Field Station

Studies of the effects of pollutants on a Plaice Tellina food chain were continued using lead. Concentrations of 5, 10, 50, 100 and 1 000 µg/l were selected to give a range between normal background levels in the sea and the 96 hr LC_{50} determined by experiment. Nutrients were added to some of the tanks to make the conditions as realistic as possible.

The assessment of other possible food chains for this work has been completed and the pelagic crustacean-sandeel claim has been selected. A suitable experimental setup is being developed.

Baseline surveys, monitoring and other pollution investigations

Work has continued, in collaboration with Torry Research Station, on baseline surveys in areas of oil-related developments. As well as general surveys of coastal and offshore areas, this project includes detailed studies of sites of special importance, and in 1974 this included Sullom Voe, Shetland, where a programme of hydrography and biological sampling was initiated by the research vessel "Mara".

Regular monitoring has been done of heavy metals in species of fish and shellfish of interest to Scottish fisheries, and a special study has been completed of levels in saithe from the North Sea and the Clyde which provides information on seasonal changes in various tissues with size of fish.

Work on the Fort William pulp mill effluent has continued in collaboration with the Oban Laboratory (SMBA) and three routine surveys were made in 1974. Emphasis has been concentrated on the distribution of fibres and their rates of settlement and decay.

Work at the Pitlochry Laboratory

Analysis of various types of samples from the marine environment for organochlorine residues continued throughout 1974. Samples of cod, whiting. herring and plaice were obtained from four coastal areas of Scotland in continuation of the six-monthly survey of contamination of commercial species which began in 1969, and the Clyde samples again showed the highest residue concentrations. The Clyde herring stock was also sampled and analysed for the four-year monitoring study, little change in dieldrin, DDT or PCB levels being found over the period 1972-1974, despite a reduction in the use and discharge of all three types of compound.

A survey of organochlorine levels in Tellina tenuis along the shores of the Firth of Clyde indicated the locations of dieldrin and PCB discharges. A further series of plankton samples from the Clyde to Weather Station INDIA in the NE Atlantic confirmed the greater level

of organochlorine contamination in the Clyde area. Analyses of seal and porpoise blubber from various coastal areas of Scotland for organochlorines have continued, and the high levels of DDT and PCB (and also dieldrin in porpoises) found in earlier years have been maintained. There is as yet no clear evidence of a significant decline in residue levels in these mammals on the east coast of Scotland, where no major discharges of the substances have been present at any time. Concentrations in Orkney and Shetland seals have always been appreciably lower, however.

Discharge of dieldrin used as a moth-proofing agent have caused significant contamination of trout and eels in a salmon river. Concentrations of dieldrin in the eels were between 2.3 and 12.6 mg/kg fresh tissue in the contaminated area, levels which would be unacceptable in other forms of food for human consumption.

A new organochlorine intercalibration sample was prepared and circulated to all laboratories engaged in this form of analysis in the ICES Baseline Study and the OECD Monitoring Programme.

As part of an investigation into the mechanisms of transport by which organochlorines enter the North Sea, an improved method of collection and analysis of precipitation samples for these residues has been developed. A series of sampling stations will be set up at coastal and inland sites in the United Kingdom in 1975.

Analyses of seal and porpoise livers for mercury residues have continued as material has become available from Scottish waters. As before, concentrations have varied widely, increasing mainly with size and/or age. In seal livers values from 0.26 to 189 mg Hg/kg, and in porpoises from 0.50 to 9.6 mg Hg/kg, were found. Mercury and the metals copper, zinc, lead, cadmium and manganese have also been determined in the flesh of samples of sea trout, brown trout, rainbow trout, grayling and eels from several areas the eels containing higher concentrations of most metals than the other species, particularly of zinc, lead and manganese. Eels in an area contaminated by mercury retained very high concentrations of the element by comparison with trout and grayling.

U.S.A.

(J.C. Sindermann)

Marine Aquaculture

Mariculture (Research and Development) is being carried out at many locations in the United States. Sources of funding for research projects are principally the U.S. Department of Commerce (through its National Oceanic and Atmospheric Administration elements - the National Marine Fisheries Service and the National Sea Grant Program) and some venture capital from private industries. Species of greatest current interest are :

Crustacea:	Penaeid shrimps, American lobster, freshwater shrimps of the genus Macrobrachium.
Mollusca:	American and Pacific oysters, hard clams, bay scallops.
Teleost fishes:	Atlantic and Pacific salmon, pompano.

Lesser efforts are directed toward pandalid shrimps, blue crabs, European oysters, abalone, striped bass, sea turtles, and selected seaweeds. Although phytoplankton and detritus feeders have not been

utilised in the United States as a source of low-cost protein, interest is developing in culture of carp and similar species which would be processed into comminuted flesh products for the mass feeding market.

Some of the more significant accomplishments in mariculture research and development in the United States in 1974 include :

1) Commercial production of 350 metric tons of pen-reared salmon on the Pacific Coast;

2) Development of a rapid, low-cost mass inoculation method for prevention of vibriosis in salt-water reared salmon;

3) Successful rearing of salmon in intensive "silo" controlled system culture;

4) Long-term survival and growth of oysters and clams in controlled recirculated systems.

5) Rearing of high densities of shrimp post-larvae and juveniles in controlled systems;

6) Farm production on Pacific islands of over 4 500 metric tons of red seaweed, and establishment and expansion of kelp beds along the Californian coast using new planting techniques.

Research and development activities which will receive new or accelerated research and development efforts in 1975 include :

1) Genetic manipulation of oysters, particularly for growth and disease resistance;
2) Intensive culture of salmon in salt water using "silo" methods and expansion of saltwater salmon culture in floating cages;
3) Development of low-cost complete diets for penaeid shrimps;
4) "Raceway" culture of juvenile penaeid shrimps;
5) "Ocean ranching" of Pacific salmon; and
6) Better understanding of the role of water quality and environmental contaminants in limiting reproduction, survival and growth.

Translating research and development activities into economically successful mariculture has been slow, and has been dampened by quiet or spectacular failures when commercial ventures encounter losses due to inadequate technology, or when economic realities of labour-intensive methods are finally confronted. Many such ventures are small and under-capitalised, and persist only briefly. Others are supported by larger industries, but are still far from economic viability. Despite these limitations, there has been expansion of mariculture research and development commitment annually, including 1974.

Pollution

Studies of the effects of coastal pollution on fish and shellfish underwent great expansion in 1974 for a number of reasons : 1) increased public concern about the effects of ocean dumping of sewage sludge and ocean sewage disposal outfalls on the coastal environment, 2) the imminent expansion of petroleum exploration and production on the continental shelves, 3) increasing legal pressures on industries to halt or reduce ocean dumping practices and 4) the need to understand ecological impacts of offshore floating nuclear gene-

generating stations, channel dredging, deep water oil terminals and artificial islands.

Principal contributors to studies include the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce, with its Marine Ecosystems Analysis (MESA) Program, and its National Sea Grant Program; the U.S. Environmental Protection Agency, through its internal system of research laboratories as well as its extramural grant program; the Bureau of Land Management of the U.S. Department of Interior - concerned with outer continental shelf oil leasing; some private utility companies, and various state, county and municipal groups.

The NOAA-MESA program of the U.S. Department of Commerce might serve as an example for the scope of U.S. coastal pollution studies. The program focuses on seriously impacted coastal areas such as the New York Bight, with well-funded studies of several years duration covering all aspects of the ecosystem, including physical oceanography, chemistry, sedimentology, and biology. Designed to assess man's general effect on coastal ecosystems, the program is responsive also to particular problems in selected areas - such as ocean dumping off New York, or petroleum contamination in Alaska. The New York Bight study, a model for subsequent projects elsewhere in the United States, entered its first full year of effort in 1974. Circulation patterns important to the ultimate disposition of dumped materials have been determined; biological effects of sludge dumping on benthic communities have been reported, and effects on fish populations - in form of reduced biomass and increased disease prevalence - have been seen.

A comparable large scale study of the effects of coastal pollution from ocean outfalls off the California coast entered its fourth year in 1974. Funded by several California counties and Sanitation districts, this study (the Southern California Coastal Water Research Project) has determined the location, nature and extent of changes in the coastal ecosystem produced by man's activities, particularly the effects of large ocean sewage outfalls.

Experimental studies of the effects of contaminants on coastal fish and shellfish species, and on food chain organisms, are carried out by a number of federal, state, and university laboratories. The National Marine Fisheries Service's Middle Atlantic Coastal Fisheries Center laboratory at Milford, Conn. produced in 1974 an extensive report on the effects of cadmium on fish and shellfish, while the NMFS Northwest Fisheries Center in Seattle examined effects of petroleum components. The U.S. Environmental Protection Agency's Gulf Breeze (Florida) Environmental Research Laboratory has a continuing major program restricted to studies of effects of pesticides and PCB's on marine organisms.

The combination of field surveys and experimental studies - carried out in areas where coastal waters have been most degraded - and combined with increased public concern, characterized the state of coastal pollution affairs in 1974.

U.S.S.R.

(D. Bogdanov)

In 1974 experimental rearing of rainbow trout and "bester" (the hybrid between beluga sturgeon and sterlet) was carried out in ponds in the

Baltic Sea. In 1974 a stock of adult pink salmon migrants of an average abundance returned to the rivers of northern Europe. Over 10 000 fish were registered in the waters of the Murmansk and Arkhangelsk regions.

In 1974 eggs were not delivered. In 1975 observations will be made on downstream migration of young pink salmon and on the run of adult migrants of pink salmon into the rivers.
